Solid State Air Purification System

Completed Technology Project (2012 - 2015)

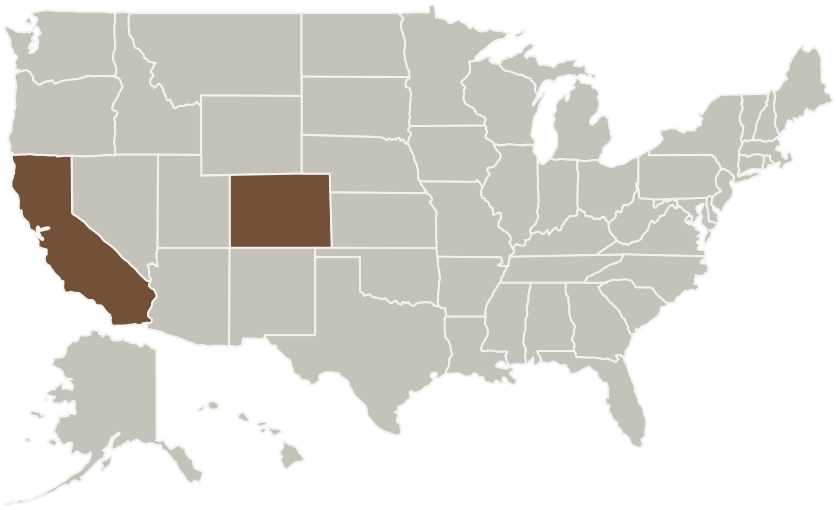
Project Introduction

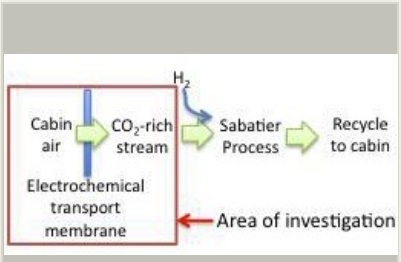
The solid state air purification project will explore feasibility of a new air purification system based on a liquid membrane, capable of purifying carbon dioxide from air in a far more compact and energy efficient system than what is currently possible. The purpose of this proposed research is to develop a new air purification system based on a liquid membrane, capable of purifying carbon dioxide from air in a far more compact and energy efficient system than what is currently possible. The approach relies on recent advances in supported liquid membranes, which allow us to make mechanically stable, ultra-thin supported liquids that have permeability and selectivity for carbon dioxide over one order of magnitude greater than existing approaches. Most critically, because these membranes use a liquid as an active material, it is possible to electrochemically pump the carbon dioxide, making it viable to build an air purification system that uses no mechanical components such as compressors. Such an innovation will dramatically improve NASA's capabilities to sustain manned spacecraft, including missions to Mars or other long-term space habitation.

Anticipated Benefits

Electrochemical membrane separations enables a system with a far smaller footprint than existing processes, works as a continuous system, and operates at lower power. The main disadvantage is that the technology is not mature. This technique offers significant advantages to NASA compared with current and future air purification technologies based on sorption.

Primary U.S. Work Locations and Key Partners





Project Image Solid State Air Purification System

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Organizations Performing Work	Role	Type	Location
eSionic Corporation	Lead Organization	Industry	Menlo Park, California
Zettacore, Inc.	Supporting Organization	Industry	

Primary U.S. Work Locations	
California	Colorado

Project Transitions

September 2012: Project Start

January 2015: Closed out

Closeout Summary: Phase I demonstrated the functionality of eSionic's approach to CO2 separation: we have established that CO2 can be removed from simulated cabin air using only electrical input, by a film in a membrane configuration. Membrane synthesis and fabrication techniques were developed that allowed for the successful incorporation and retention of an electrochemically active carrier molecule with eSionic's composite liquid membrane technology. This allowed for the successful demonstration of a continuous CO2 capture rate at 40% in a single step with no moving parts. Higher capture rates of 80% was also demonstrated in a batch mode during this phase, showing the feasibility of this technology for highly efficient, low energy separation of CO2 in space exploration activities. Based on these results and efforts during this phase of the program, it is projected that this technology has the potential of replacing the current CRDA on-board ISS with an operational energy savings of 80% in a weight and size footprint that is 75% smaller. eSionic's key enabling technology - composite liquid membrane materials - allows creation of a functional electrochemical membrane in a thin film form factor that enables this technology and application. The next step in the development is to improve the reliability of electrochemical membranes such that they can be deployed in the field. In Phase II, we will demonstrate the reliability of our system to continuous operation in humid air and we will develop a full system for a prototype air purifier.

Organizational Responsibility

Responsible Mission Directorate:
Space Technology Mission Directorate (STMD)

Lead Organization:
eSionic Corporation

Responsible Program:
NASA Innovative Advanced Concepts

Project Management

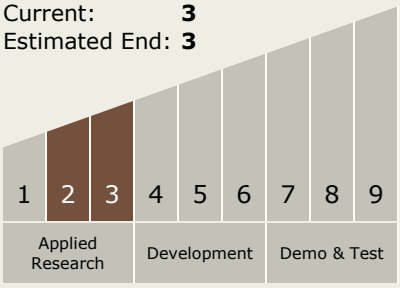
Program Director:
Jason E Derleth

Program Manager:
Eric A Eberly

Principal Investigator:
Wayne Gellet

Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**



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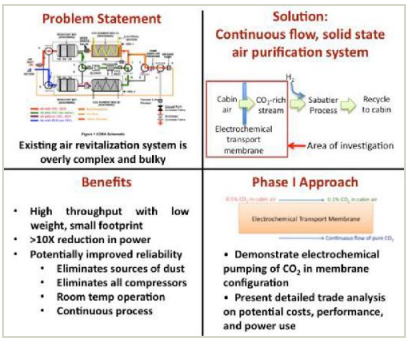
Images



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Project Image Solid State Air Purification System
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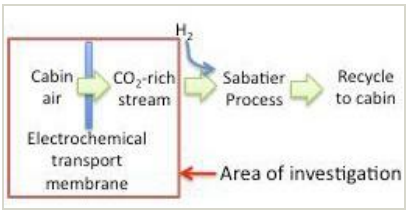

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Project Image Solid State Air Purification System
(https://techport.nasa.gov/image/102125)

Technology Areas

Primary:

- TX06 Human Health, Life Support, and Habitation Systems
  - TX06.1 Environmental Control & Life Support Systems (ECLSS) and Habitation Systems
    - TX06.1.1 Atmosphere Revitalization

Target Destinations

The Moon, Mars, Earth